

Claims

What is claimed is:

1. A semiconductor device, comprising:
  - a semiconductor region, in which an impurity of one conductivity type is doped;
  - a gate insulation layer, formed on the semiconductor region;
  - a gate electrode, formed on the gate insulation layer;
  - a lightly doped layer, formed in a region from the principal surface to a first depth of the semiconductor region, in which a first impurity of the other conductivity type is implanted into the semiconductor region with a first dose amount; and
  - a heavily doped layer, formed in a region from the principal surface of the semiconductor region to a second depth, which is shallower than the first depth, in which a second impurity of the other conductivity type is implanted into the semiconductor region with a second dose amount in a range of the first dose amount or more to  $1 \times 10^{15}/\text{cm}^2$  or less.
2. A semiconductor device, comprising:
  - a semiconductor region, in which an impurity of one conductivity type is doped;
  - a gate insulation layer, formed on the semiconductor region;
  - a gate electrode, formed on the gate insulation layer;

a lightly doped layer, formed in a region from the principal surface to a first depth of the semiconductor region, in which a first impurity of the other conductivity type is implanted into the semiconductor region with a first dose amount; and

a heavily doped layer, formed in the depth direction from the principal surface of the semiconductor region, in which a second impurity of the other conductivity type is implanted into the semiconductor region with a second dose amount so that a peak position of the concentration exists at a second depth position, which is shallower than the first depth by 0.15  $\mu\text{m}$  or more.

3. A semiconductor device, comprising:

a semiconductor region, in which an impurity of one conductivity type is doped;

a gate insulation layer, formed on the semiconductor region;

a gate electrode, formed on the gate insulation layer;

a lightly doped layer, formed in a region from the principal surface to a first depth of the semiconductor region, in which a first impurity of the other conductivity type is implanted into the semiconductor region with a first dose amount; and

a heavily doped layer, formed in the depth direction from the principal surface of the semiconductor region, in which a second impurity of

the other conductivity type is implanted into the semiconductor region with a second dose amount in a range of the first dose amount or more to  $1 \times 10^{15}/\text{cm}^2$  or less so that a peak position of the concentration exists at a second depth position, which is shallower than the first depth by  $0.15 \mu\text{m}$  or more.

4. The semiconductor device according to any of claims 1 through 3, wherein the one conductivity type is N-type and the other conductivity type is P-type.

5. The semiconductor device according to any of claims 1 through 3, wherein the second impurity is arsenic.

6. The semiconductor device according to any of claims 1 through 5, comprising a trench structure that isolates the semiconductor region.

7. A method of manufacturing a semiconductor device, comprising:  
forming a semiconductor region by doping an impurity of one conductivity type;

forming a gate insulation layer on the semiconductor region;

forming a gate electrode on the gate insulation layer,

forming a lightly doped layer in a region from the principal

surface to a first depth of the semiconductor region by implanting a first impurity of the other conductivity type into the semiconductor region with a first dose amount; and

forming a heavily doped layer in a region from the principal surface of the semiconductor region to a second depth, which is shallower than the first depth, by implanting a second impurity of the other conductivity type into the semiconductor region with a second dose amount in a range of the first dose amount or more to  $1 \times 10^{15}/\text{cm}^2$  or less.

8. A method of manufacturing a semiconductor device, comprising:

forming a semiconductor region by doping an impurity of one conductivity type;

forming a gate insulation layer on the semiconductor region;

forming a gate electrode on the gate insulation layer;

forming a lightly doped layer in a region from the principal surface to a first depth of the semiconductor region by implanting a first impurity of the other conductivity type into the semiconductor region with a first dose amount; and

forming a heavily doped layer in the depth direction from the principal surface of the semiconductor region by implanting a second impurity of the other conductivity type into the semiconductor region with a second dose amount so that a peak position of the concentration exists at a

second depth position, which is shallower than the first depth by 0.15  $\mu\text{m}$  or more.

9. A method of manufacturing a semiconductor device, comprising:
  - forming a semiconductor region by doping an impurity of one conductivity type;
  - forming a gate insulation layer on the semiconductor region;
  - forming a gate electrode on the gate insulation layer;
  - forming a lightly doped layer in a region from the principal surface to a first depth of the semiconductor region by implanting a first impurity of the other conductivity type into the semiconductor region with a first dose amount; and
  - forming a heavily doped layer in the depth direction from the principal surface of the semiconductor region by implanting a second impurity of the other conductivity type into the semiconductor region with a second dose amount in a range of the first dose amount or more to  $1 \times 10^{15}/\text{cm}^2$  or less so that a peak position of the concentration exists at a second depth position, which is shallower than the first depth by 0.15  $\mu\text{m}$  or more.

10. A semiconductor device, comprising:
  - a semiconductor region, in which an impurity of one conductivity type is doped;
  - a gate insulation layer, formed on the semiconductor region;
  - a gate electrode, formed on the gate insulation layer; and
  - a heavily doped layer, formed by implanting a second impurity of the other conductivity type into the semiconductor region with a second dose amount of  $1 \times 10^{15}/\text{cm}^2$  or less.